

IBDP computer science

Topic 7 Control

Past paper questions

1.

A network of analogue gas detectors and digital particle counters has been installed in a town. These detect the presence of different pollutants. The collected data are transmitted to a control centre, where they are processed overnight by a computer.

- (a) Define the term *analogue data*. [1 mark]
 - (b) Explain why it is necessary to convert the data from the gas detector from analogue to digital. [2 marks]
 - (c) Discuss the appropriateness of using polling for the communication of the data. [4 marks]
 - (d) Describe how the computer could sort the data without increasing the size of its primary memory. [3 marks]
-
- (a) Data that can be represented by a continuous function; [1 mark]
 - (b) Conversion is necessary before transmission;
Because a network is used to transmit further digital data to a control centre (computerized centre);
Data in digital form can only be stored/processed by the computer; [2 marks]
 - (c) *Award up to [4 marks max].*
Polling allows the centre to better use its processing resources;
And to perform more significative data collection, with respect to the subsequent analysis;
For example, the centre can decide to poll the devices;
In times of lower use of its processing units;
Or in specific times when the quality of the air is known to be worse; [4 marks]
 - (d) *Award up to [3 marks max].*
(RAM insufficient to store data, data are in disk)
Use sort-merge strategy/external sort to sort data in disk;
Portions of data are sorted and stored in temporary files;
Temporary files are merged afterwards; [3 marks]

Total: [10 marks]

2.

An automated security system monitors a prison.

- (a) Suggest the sensors that could be used to detect any person crossing the perimeter. [2]

A team of security guards patrols the perimeter of the prison at night. The guards each carry a device incorporating a GPS that links to the prison's security system.

- (b) Outline a suitable output that would notify a guard that a prisoner has escaped. [2]

The guards' GPS devices transmit information to the security system.

- (c) Suggest the most suitable method for the transmission

(i) between the perimeter's sensors and the security system; [1]

(ii) between the security system and the guards' devices. [1]

- (d) State **one** method of network security that could be used when transmitting the GPS information. [1]

- (e) Outline how this GPS information may be used once transmitted to the security system. [2]

There are other situations where people may be required to carry GPS devices.

- (f) Discuss the ethical implications of insisting people carry GPS devices. [6]

- (a) *Award up to [2 marks max].*

Movement sensor;

Touch sensor / pressure;

Heat sensor (infrared);

[2 marks]

- (b) *Award [1 mark] for the method and [1 mark] for how it is delivered, up to [2 marks max].*

Flashing light / Text message;

Appears on device;

OR

Siren;

Fitted around prison;

[2 marks]

(c) (i) Cable; [1 mark]

(ii) Award up to [1 mark max].
Satellite;
Radio;
Wi-fi transmission; [1 mark]

(d) Encryption; [1 mark]

(e) Award up to [2 marks max].
Security system can make sure guards are in correct place/area;
Make sure guards are moving;
See who is closest to an incident; [2 marks]

(f) Award up to [6 marks max].
Award up to [2 marks] for an argument for people carrying GPS.
Award up to [2 marks] for an argument against people carrying GPS.
Award up to [2 marks] for some comparison and conclusion.

Examples:

People who are under house arrest can be controlled/monitored by the authorities;
Allowing a curfew or restricted movement to be enforced;
Which is preferable as otherwise they would be locked up;
Children forced by parents/teachers to carry a device;
Creates a lack of trust / infringes on their liberties;

Accept appropriate conclusion based on candidate's examples. [6 marks]

Total: [15 marks]

3.

A builder is renovating a series of apartments and is considering integrating a few electrical devices in each apartment into an automatic programmable system. One example is the integration of lighting, heating, ventilation and air conditioning.

(a) Identify **two** groups of users that might find this integrated technology particularly appealing. [2]

(b) Discuss **two** advantages, offered by this technology, that could be used in an advertisement for the apartments. [4]

(c) Evaluate **two** ways users can access the functionality of the integrated system at home. [6]

The same technology is adapted and used for intensive chicken farming; in this context a decentralized control is preferred.

(d) Describe how this could be achieved. [3]

- (a) *Award up to [2 marks max].*
 Elderly;
 Disabled;
 Commuters;
Accept other reasonable answers. **[2 marks]**
- (b) *Award [1 mark] for advantage and [1 mark] for explanation, for two items, up to [4 marks max].*
 Improved convenience;
 One can better control times of functioning, hence costs;

 Improved comfort;
 One can program the functions according to their specific needs;

 Energy efficiency;
 One can program/plan the functions based on the surrounding environment and reduce energy waste (interconnected systems);

 Safety;
 Programmed in a way to avoid electric overload and faults;

Accept other reasonable answers. **[4 marks]**
- (c) *Award up to [6 marks max].*
Award up to [3 marks max] for each of the two ways.
Award [1 mark] for the way of access and up to [2 marks] for two additional points, which could be advantages or disadvantages.
Examples include fixed/non-fixed installations, digital/analogue.

 Computer based/TV-based control;
 The user always knows where the control is;
 Because the device may not be portable;
 Inconvenient if computer/TV already being used by someone else;

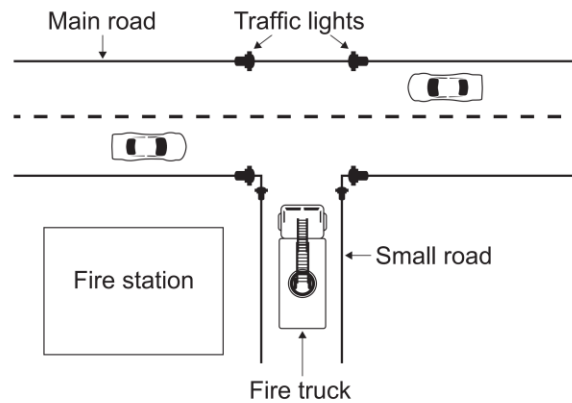
 Touch screen/keypads in fixed installation;
 Ergonomic gadget/small dimensions/cheap device;
 Wide range of different designs to fit different locations in a house;
 Difficult to lose;
 Inconvenient to operate some devices by having to go to a fixed panel/not suitable for extended use to operate TVs etc;

 Smartphone;
 Portable/useful for some groups of users (limited mobility);
 Can be easily extended to include other devices;
 Could be lost or misplaced;
 Requires internet/Wi-Fi/signal to operate;
Accept other suitable answers. **[6 marks]**
- (d) *Award up to [3 marks max].*
 Transmission: integrated wiring or internet or wireless;
 Requires: extended/dedicated network and hw/sw for protocols/transmissions and sensors/actuators;
 Use: The farmer can vary the parameters/environmental conditions from home at any time and better concentrate on other activities (eg trade with KFC); **[3 marks]**

Total: [15 marks]

4.

In a town, a set of traffic lights control access from a small road, where a fire station is located, to a main road that has heavy traffic. In times of emergency, many vehicles from the fire station may need to leave the station at the same time. A system is put in place so that when a fire truck on the small road approaches the main road, the traffic lights switch to green (Go) on the small road and to red (Stop) on the main road.



- (a) Outline the role of sensors and a microprocessor in controlling the traffic lights in this way. [4]
- (b) Suggest how the traffic lights can be changed back to their original state once there are no more fire trucks coming from the small road. [3]

These traffic lights are controlled by embedded systems at the point of use. It is proposed that they should be controlled from the same central computer as all the other traffic lights in the town.

- (c) Discuss the **advantages** and **disadvantages** of running the town's traffic light system on one central computer with multiple inputs and outputs. [5]

A series of cameras are installed at each of the town's traffic lights. These cameras are connected to the central computer.

- (d) Discuss the social implications of monitoring traffic in this way. [3]

- (a) Sensors will be used to detect the approach of a vehicle from the minor road;
Likely to be touch/weight sensor embedded in the road;
Sensor input is converted from analog to digital;
To be processed and;
Signal sent to switch traffic lights; [4]

- (b) *Award up to [3 marks max].*
Continual feedback from sensor to processor;
A calculation based on number of vehicles/speed/etc or time taken for a vehicle to pass;
(Timer) resets if another vehicle is detected;
Once no input for a certain time traffic lights changed back; [3]

- (c) *Award [2 marks] for advantages, [2 marks] for disadvantages and [1 mark] for weighing up.*

Disadvantages:

Central computer would have to cope with inputs from many places;
With differing priorities which could take time;
Connection failure possible from a particular point;
Computer failure puts all lights in the area out;
Cost of communication system/central control system;

Advantages:

More control over traffic flow at these points;
Lights can be adapted from distance to avoid traffic blocks;
Any problem appearing at one point is known immediately and can be dealt with;
Cheaper as no need for communication software/hardware/control centre;
Can react/change rules to changing levels of traffic flow;

Overall, it would be better to ... (*appropriate conclusion*); [5]

- (d) *Award [1 mark] for an advantage outlined, [1 mark] for a disadvantage outlined and [1 mark] for discussing.*

For example:

Controlling the movement of vehicles and identifying people who speed should help to reduce accidents (as motorists know that they will be caught if driving dangerously);
This could also save lives;

Individual displacement is tracked;
Which can be seen as an infringement on personal liberty/a breach of privacy;
In some cases the information could be used unjustly against the individual (eg in times of political unrest);

It comes down to physical safety on the road against privacy/personal liberty; [3]

5.

A control system is used to control sliding doors which automatically open to allow people in and out of a shop.

- (a) (i) Identify **one** type of sensor in this system. [1]
- (ii) Identify **one** piece of hardware, other than sensors, that is part of the control system. [1]
- (iii) With reference to the role of sensors, outline the sequence of steps within the computer control system that will take place when a person approaches the door. [3]
- (b) (i) Define the term *interrupt*. [2]
- (ii) Describe a situation in this system where an interrupt would occur. [2]
- (c) Discuss the contribution of computer control systems in industry where they replace human workers. [6]
-
- (a) (i) *Award up to [1 max].*
Proximity;
Movement;
Pressure; [1]
- (ii) *Award up to [1 max].*
Transducers;
AD converters;
Actuators;
Micro-processor; [1]
- (iii) *Award up to [3 max].*
When a person approaches, sensors activate;
Signal sent to processor;
Which sends signal to actuator/transducer (which opens doors);
After fixed time/no further sensory input, doors close; [3]
- (b) (i) *Award up to [2 max].*
Interrupt is a signal sent to the processor;
Sent by hardware or software;
Indicating an event that needs the processor's immediate attention; [2]
- (ii) If a second person approaches the door while it is closing;
This will interrupt the processing cycle and the door will re-open; [2]

- (c) Award **[1]** for an advantage/disadvantage and **[1]** for an expansion, for 3 examples, up to **[6 max]**.

Example discussion points:

Labour cost;
Quality of work;
Retraining;
Redundancy;
Performance (of repetitive tasks);
Productivity;
Safety;

Example answer:

Initially a computer system is more expensive;
Once the computer control system is installed/set up it is more economical;
(Over longer period of time), than human labour;
Computers can work accurately;
7 days/24 hours;
Performing monotonous/unpleasant tasks without complaining;
In dangerous conditions (fumes, poison, lifting heavy weight, etc);

[6]